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PREFACE

The present booklet is based upon the extensive experience of The Travelers Insurance Company, in practical accident-prevention work. We are therefore confident that it will be welcomed not only by superintendents and foremen, but also by owners and operators of industrial plants and by all other employers of labor. It is addressed to "foremen", but it is intended for the use of all persons holding positions of authority, the word "foremen" being used throughout the text merely for the sake of avoiding a useless and tiresome repetition of titles, when persons in authority are mentioned.

It should be studied in connection with the companion booklet, previously issued by The Travelers Insurance Company under the title "*The Employee and Accident Prevention*". The earlier one takes up the subject from the standpoint of the worker, who has but little power to modify the conditions under which the work is done, and the present one approaches it from the

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point of view of the executive and administrative departments, and gives suggestions with regard to the management of the workers and the improvement of the plant, with a view to increased safety.

Believing that the booklet would be more useful if it were kept as small and compact as practicable, we have confined our attention mainly to the points that are found by experience to be of marked importance in all industries. Other publications of similar nature have been issued, and still others are in preparation, dealing more fully with the hazards that are peculiar to special industries, or which become greatly emphasized in such industries. Inquiries with regard to points that are not covered in these pages, or which, owing to the existence of unusual conditions, require more elaborate discussion than they have here received, will be welcomed by our Engineering and Inspection Division, and will receive careful attention.

THE TRAVELERS INSURANCE COMPANY,
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Foremen and Accident Prevention

RELATION OF THE FOREMAN TO THE EMPLOYEE: The success of any accident-prevention campaign will depend largely upon the nature of the relation between the foremen and the employees over whom they are in authority. The foreman must be considerate of the men and women working under him. He should take a genuine and sympathetic interest in their welfare, but he should never lose his sense of dignity and leadership, nor be cordial to the point of familiarity. He ought to maintain a certain amount of unobtrusive reserve, which will be instinctively felt by the workers, rather than forced upon their notice by arbitrary acts and orders. (See DISCIPLINE.) If the workers realize that the foreman is a man of the right type they will usually be ready and willing to follow his instructions in spirit as well as in letter; and this makes discipline easier to maintain, and helps wonderfully toward the prevention of accidents. The establishing of an ideal relation between the foreman and his workers is a problem which frequently calls for all that a man has of tact and of insight into human character. Above all, the foreman should be fair to those under him, and personal likes or dislikes should never influence him in the least, in any matter connected with the work. Even though his rules and orders involve hardship, they will be respected if it is evident that they are intelligent attempts to cope with the conditions under which the work must be done, and that they are just.

The foreman must obey all the rules himself, however onerous they may be; and he should be particularly careful to conform with those that are established for securing safety. Breaking a safety rule is a dangerous act in itself, and it also sets a bad example, which the employees are likely to follow. A foreman who issues a safety order and then violates it himself, can hardly expect the employees under him to believe that it is of great importance. Such a violation on the part of a foreman minimizes the effect not only of that order, but of others as well.

Careful selection of employees is important, and it should be undertaken with due regard to the nature of the work to be done. A man who is naturally slow should not be required to operate machines that call for rapid movements or quick judgment, nor to engage in any kind of work demanding marked activity of mind or body. Points of this kind should be carefully considered, and it may be necessary to shift some employees several times before their capabilities and limitations can be ascertained, and they can be assigned to the work for which they are best fitted.

It sometimes happens that little can be done in the way of adjusting the work to the worker. The help that is available may be such that classification and selection are not feasible, or the work may be so urgent and pressing that it is beyond the power of the foreman to consider all the employees individually and treat them in an ideal way. He should bear in mind the importance of the foregoing suggestions, however, and should apply them advisedly. He should not try to persuade himself that the task is impossible, if the real reason is that he shrinks from making the effort. Much can often be accomplished when the conditions, at first thought, appear forbidding, and the difficulties insuperable.

Among the gravest responsibilities of the foreman are those that relate to the protection of the workers from the effects of their own carelessness, inexperience, ignorance, or poor judgment. Some of these matters are considered under various headings in the following pages. (In particular, see Carelessness, Foreigners, Instruction, Sickness, and Unemployed Persons.)

Finally, the foreman should be entirely sincere, in every way and at all times. The safety rules that are in force at the workplace should be absolute and paramount, and the foreman should never criticize a worker in the smallest degree, either in word or in thought, for following them. "Self-preservation is nature's first law", and it should also be, without question, the first law of the workplace.

ACIDS: See Chemicals.

AIR: See Compressed Air.

ALCOHOL: All supplies that contain alcohol should be placed in the custody of some trustworthy person, who should be held responsible for their proper use. (See also Intoxication, and Wood Alcohol.)

ARTIFICIAL RESPIRATION: All foremen should thoroughly understand at least one of the

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standard methods of maintaining artificial respiration. It is not sufficient to understand the principles upon which it is based. It is important to have a practical, working knowledge of the subject, which can be effectively applied without the least delay. The time to acquire this knowledge is before the need for it arises; because a delay of a minute after the accident, or even of half a minute, may mean all the difference between life and death. Electric shocks and partial drowning are the most prominent causes of cessation of breathing, but there are many other causes also, and no time should be lost in giving immediate treatment when a person stops breathing for any reason whatsoever, unless it is absolutely certain that the unfortunate one is dead and wholly beyond the possibility of resuscitation. In electric plants and other places in which accidents calling for artificial respiration are likely to occur, a considerable number of other persons should have a practical knowledge of the subject, in addition to the foremen. In such places lungmotors or other effective mechanical devices for restoring respiration should be installed; but appliances of this kind should be regarded as supplementary, and possession of them should never be considered to justify ignorance of the methods by which artificial respiration may be induced without mechanical aid. If *pulmotors* are installed, it should be the duty of some specially designated person to see that a plentiful supply of compressed oxygen is always on hand. Above all, it should not be forgotten that promptness of action is highly important, and that the efforts at restoration should be kept up continuously for two or three hours, before hope is abandoned. (See also SANITARY CONDITIONS.)

BELTING: Belts should never be run under excessive tension. It is safer and more economical to keep them as loose as they can be operated without danger of slipping. If they will not transmit the required power without being kept too tight, they are too narrow, or the pulleys are too small, or there is some other trouble which should be discovered and remedied at once. A space at least equal to the width of the belt should always be allowed between every pulley and the one nearest to it on the same shaft (except in the case of tight-and-loose pulleys that are operated together), and also between every pulley and the nearest hanger, so that the belt cannot get wedged and pull the line shafting down. If it is not possible to arrange the pulleys in this way, the spaces should be effectively guarded, so that the belts cannot get into them.

Every overhead horizontal belt should be guarded on the sides and bottom, when the lower side of the belt is 7 feet or less from the floor or platform level. If both sides of a horizontal belt are within 6 feet of the floor level the guard should extend at least 15 inches above the belt, but the guard need not be more than 6 feet high. Belts 24 inches or less from the floor should be entirely inclosed, or protected by standard railings.

Vertical belts should be guarded to a height of at least 6 feet above the floor, if the guards are within 4 inches of the belts or pulleys. Under these conditions the guards may be of wire mesh, or of expanded, perforated, or sheet metal, or of wood; but the openings in the guards should not exceed ½ of an inch in diameter. If the guards are more than 4 inches but less than 15 inches from the belts or pulleys, the openings may be larger, but they should not exceed 2 inches in diameter, and the guards should be at least 5 feet high. Standard railings, 42 inches high, may be used for guarding vertical belts, provided they are between 15 and 20 inches from any part of the belt. Guards for inclined belts should be so installed that a line projected vertically from the outside of the guard would intercept the lower side of the belt at a height of not less than 6 feet 6 inches from the floor.

When a belt is removed from a pulley, a hook or a belt-perch should be provided for the support of the belt, so that it will not hang directly in contact with the revolving shafting. Belts should be inspected frequently, and should be kept in a safe condition in every respect. Men should never be allowed to pass through moving belts unless a safe and thoroughly protected passageway is provided. Workmen should not be permitted to shift belts with their hands. A good mechanical belt-shifter (or an equally good clutch) should be provided at every machine, and at every other point where shifting has to be done. The handles of mechanical belt-shifters that are suspended from overhead should be arranged so as to hang vertically when the belt is on the loose pulley, and to be locked when in this position.

The ends of belts should preferably be joined by glued splices, which should be made by men well skilled in this kind of work. The best quality of animal glue should be used, and the belt should be skived down carefully, so that the lap is proper in all respects. When belts are laced the ends should be butted together neatly and smoothly, and the holes for the lacing should be kept well away from the edges. Ragged ends of belts and loose ends of lacings should be trimmed off neatly, and never be left whipping about.

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Belts should never be spliced or tightened while any part of the machinery to which they are attached is in motion.

BELTS: See SAFETY BELTS.

BLASTING: The blasting supplies that are used should be of the best quality obtainable, in all respects. No makeshift methods of any kind should be allowed, and all blasting operations should be performed under the immediate personal supervision and direction of men known to be experienced, and to be cautious and wholly trustworthy. The most stringent rules should be established and rigidly enforced against smoking, or using artificial lights of any kind (except incandescent electric lamps protected by vapor-proof globes), anywhere near black powder, dynamite, or blasting caps. Black powder, when being handled, often gives off a fine inflammable dust, which may ignite from a flame a considerable distance away, and carry the flash to the main charge of powder almost instantaneously.

Explosives should be stored in a special building, which should be kept locked, and no person should have a key to it but the foreman himself. The storage place should be isolated from all other buildings, and should stand at a safe distance from the workplace, and from all roadways, pathways, and other thoroughfares. The total quantity of explosive kept in storage should be no greater than is required for the work in hand. No more of it should be removed from the storage place, at any one time, than is necessary for the next blast; and this should be left in the storage house until the holes are ready to receive it. A wooden mallet and wedge should be used in opening boxes that contain dynamite, and the blows that are struck should be as light as possible. A pick handle sharpened to a blunt edge at one end makes a good wedge, and it is also serviceable for prying off the cover. Blasting caps and electric blasting caps should never be stored in the same building with dynamite or other high explosives.

Dynamite should never be used while in a frozen or partly-frozen condition, and sticks of it should never be slit, or bent, or kneaded, or otherwise manipulated while in this state. Frozen dynamite should be carefully thawed before use, in *special thawing kettles* heated by warm water, or in some other safe and approved way. It is highly dangerous to thaw dynamite by warming it in front of a fire, or by placing it in ovens, or on shelves over stoves or steam radiators.

Electrical shot-firing is to be preferred, because the charge can then be set off at any distance desired, the firing instant can be exactly determined, and accidents due to retarded and premature firing are largely eliminated. If fuse is used, it should be in first-class condition, and should not be brittle, nor defective in any way whatsoever. Damaged or inferior fuse often causes blasts to be premature, or to be delayed. Blasting caps should always be fastened to fuse by a crimping tool, specially made for the purpose. It is highly dangerous to use the teeth for this purpose, or to employ any other makeshift method. The caps should not be attached to the fuse in or near the storage house, and they should not be inserted in the cartridges until just before these are placed in the holes, ready for tamping.

The stemming (or tamping) should consist of clay or of loosely-shaken dry sand, so that no sparks may be produced. The tamping rods should be made wholly of wood. Steel or iron rods should never be employed, under any circumstances; and the wooden rods should never have iron ferrules, nor contain tacks or nails, nor have any other metal parts whatsoever.

When a shot is about to be fired, all persons who are near the place should receive ample warning, and the fuse should not be lighted until it is absolutely certain that every one has been warned, and that no one is in a dangerous position. A charge that has misfired should not be approached for at least two hours, and it is safer to leave it for an entire day, before making an examination. No attempt should be made to fire a charge that has failed to explode the first time, nor to tamper with it in any way. A new hole should be drilled about two feet from the first one, and a fresh charge inserted in it and fired.

BLOOD POISONING: See INJURIES.

BOARDS: See CONSTRUCTION WORK, FLOORS AND PASSAGEWAYS; and SLIVERS.

BOILERS AND OTHER STEAM APPARATUS: Every boiler should be provided with a reliable safety-valve, installed in such a way that it cannot be shut off from free communication with the boiler. Safety-valves should be tested at least once a day, to see that they are in good working order. Steam-gages and water-gages should be tested from time to time, to make sure that they register correctly. The water-level in the boiler should be maintained at the proper height, under all circumstances, and the chief engineer should see that this matter is in the hands of a thoroughly responsible and trustworthy man. Water-gage glasses should be guarded so as to protect the eyes of the water-tender and other persons in case of breakage, but the guard that is used should not prevent a clear view of the level of the water in the glass. Steam-gages and water-glasses should be well lighted, so that there will be no possibility of mistaking their indications. Gage glasses should be renewed when they become too dirty to allow the water-level to be seen distinctly and certainly.

The steam piping should be properly supported and anchored, and the main steam header and other steam lines should be installed so that they can expand and contract, with variations of temperature, without being subjected to severe stresses. Pipe lines should not be run along floors in exposed places, where persons may stumble over them. Steam pipes should be arranged to drain in the direction of the steam flow, and suitable drain-pipes, discharging into traps, should be provided wherever there is a chance for water of condensation to collect. Before opening any valve on a steam pipe, great care should be taken to see that the pipe is free from water. This applies with special force to the valves on steam pipes supplying engines, because it is usual for these to pass downward for a distance of several feet, just above the engine stop-valve. The vertical part of the pipe becomes more or less completely filled with water of condensation, when the engine is idle, and it should therefore be drained with special care before the engine is started. There should be two valves on each connection from a boiler to a steam header, one of which should be of the "non-return" type. The part of the pipe between these two valves is likely to become more or less completely filled with water, if the valve nearest the main steam header leaks and both valves are kept closed while there is pressure in the header. Drain-pipes should therefore be provided for all spaces of this kind, and any water that may collect in the pipe should be carefully drained away before either of the steam valves is opened.

Valves of every kind should be opened and closed slowly and cautiously. (This is particularly true of the main stop-valve in the steam line, and of the blowoff valve or cock.) Steam from a blowoff pipe or a safety-valve escape pipe should not discharge directly into a passageway, nor into any place where persons may have occasion to go. Pits in boiler rooms should be guarded or covered over. Safe means of access to all valves should be provided, and walks should be constructed along the tops of the boilers of each battery, to give access to the valves and other appliances. These walks should be properly railed and lighted and should extend across all the boilers, and stairs or stationary iron ladders should lead to them from the floor level. Boiler rooms should have at least two exits, and these should be located at opposite sides of the room to facilitate the escape of the employees in case of emergency. An additional exit, at the rear of the boilers, is strongly recommended.

Engineers, foremen, and all other persons in authority should see to it that no repairs of any kind, however slight they may be, are made upon any boiler or other vessel, nor upon any pipe or fitting, until the pressure has been *entirely removed.* The chief engineer or foreman should also see to it that no person is allowed to enter a boiler until all the valves on pipes leading to it or from it (including the blowoff pipe) have been tightly closed and locked. The man entering the boiler should also be required to report when he is about to go into it, and again when his work is completed. If there is steam upon any other boiler in the plant, that could possibly be placed in communication with the boiler that is to be entered, a danger sign should be attached to the wheel or handle of the stop-valve of the boiler into which the workman is to go, and this wheel or handle should also be securely locked in the closed position.

Special care should be exercised when a boiler that has been out of use for a time is again restored to service, and put in communication with other boilers under pressure. In performing this operation (which is known as "cutting-in" a boiler) the steam pressure on the boiler that is to be cut in should be *exactly* equal to that in the main steam pipe, before the stop-valve on that boiler is opened; and when this stop-valve *is* opened, it should be handled carefully and opened slowly and with great caution. If any unusual noise or vibration is produced, it should be closed again, *immediately*. Similar care should be taken in handling a blowoff valve, because many serious accidents occur in consequence of the great stresses that are produced in blowoff pipes by opening or closing their valves or cocks too quickly.

The boilers should be insured and regularly inspected by a reliable insurance company employing boiler inspectors of wide experience. THE TRAVELERS INDEMNITY COMPANY is particularly recommended, because its men and its methods are of the highest order of excellence, and its inspections are made in strict conformity with the best modern engineering practice in all respects.

BREATHING: See ARTIFICIAL RESPIRATION.

BUILDING: See Construction Work, and Wrecking.

CAISSON WORK: See Compressed Air.

CARELESSNESS: The thoughtlessness of employees and their willingness to "take a chance" even when the possibility of accident is well understood, are two of the greatest obstacles with which the foreman has to deal in his effort to secure safety. He should therefore take special pains to discourage everything of this kind, and should make it perfectly plain to those under him that the management is very much in earnest in its desire to avoid accidents. He should be watchful for careless acts of every kind, and should always visit the offender with an emphatic expression of his displeasure. Gross carelessness, and the persistent and wilful performance of careless acts against which the offender has several times been warned, should be dealt with as severely as the circumstances of the case may require. The foreman should also call attention, repeatedly and forcibly, to the fact that it is the workers themselves who should be most deeply interested in exercising care. The employer pays for accidents only with dollars, while the workers pay with injuries, or even with life itself.

CAUSTIC: See CHEMICALS.

CHAINS: See HOISTING MACHINERY.

CHEMICALS: All open vats and pans should be guarded by railings, or in some other equally effective way. Single planks should never be used for walks across open vats filled with chemicals or acids. No walks of any kind should be used in such places, if they can be avoided; and if they are really necessary they should be strongly built and protected by standard railings. Many acids and chemicals cause wasting away and deterioration of metallic objects, even when these are not in immediate contact with the liquid. Metal vats, pans, railings, tools, and other metallic objects or structures used in connection with corrosive chemicals should therefore be inspected frequently, and any that are corroded should be replaced before their condition becomes dangerous. Eye protectors, respirators, and gloves of resistant material, should be provided for workmen engaged in handling dangerous acids and chemicals. The men should also be required to wear rubber boots, or congress shoes fitting closely around the ankles, in order to avoid burns from the entrance of acids or other corrosive liquids through the spaces of ordinary shoes, in case these liquids are spilled on the feet. Only boots or shoes that are free from holes or cracks should be worn.

Smoking should be prohibited in rooms containing chemicals, and no matches should be carried into rooms containing explosive or inflammable substances of any kind. If explosive substances are present the workmen should be forbidden to wear shoes containing nails; belts for driving machines, which might give off sparks of static electricity, should be excluded from the rooms; electric motors, fuses, switches, and other similar apparatus should be situated outside of the dangerous area; the artificial lighting should be only by incandescent electric lamps with vapor-proof globes; and all other possible precautions should be taken to prevent sparks from any source. (See also ELECTRICAL APPARATUS.)

Acids and chemicals should be carefully stored, preferably in isolated rooms, buildings, or tanks, and all possible precautions should be taken to prevent leakage and waste. Cracked or otherwise damaged containers should be carefully examined before the men are permitted to touch them, and the foreman should personally supervise the handling of all vessels of this kind. If they are in a dangerous condition they should be immediately discarded, and it is safest to destroy them so that they cannot be used again.

Corrosive, poisonous, or otherwise dangerous liquids, when used in considerable quantity, should be stored and handled in closed apparatus, so as to minimize the hazard incident to their use. When it is necessary to transfer such liquids from one place to another, they should be delivered through pipe lines, by means of gravity, or compressed air, or power pumps, or (in some cases) by displacing them with water. When it is impracticable to adopt a procedure of this kind, on account of the small amount of material to be handled, other safe methods should be used, which are adapted to the special conditions that must be met. In handling carboys of acid, for example, inclinators or other approved transporting and tipping devices may be employed, so that the acid may be poured out with due regard to safety. Special acid pumps may often be used to great advantage in such cases.

Men who have to handle dangerous chemicals should never be permitted to work alone. There should be at least two men in every room, so that an injured man may have immediate assistance.

Antidotes and first-aid outfits should be at hand, and one or more of the workmen should be fully instructed with regard to the treatment that should be given in all emergencies that are likely to arise. In case of an accident of any kind, however, a physician should be summoned at the earliest possible moment, the treatment given by the foreman or by fellow workmen being regarded as merely temporary.

Special instructions and rules, in relation to the unusual dangers of the work, should be issued by the foreman or by some other person in authority, and these should be rigidly enforced. All chemicals should be labeled plainly and conspicuously, and marked "Poison". So far as practicable, the more dangerous substances should be kept under lock and key; and no person should be allowed to enter any place where dangerous chemicals are stored or used, unless his work requires him to do so.

CHIPPING: Workmen engaged in chipping metal, stone, concrete, or other similar substances, should be provided with eye-protectors and be required to wear them. The men should not be permitted to work with battered or otherwise defective tools. Hammers, chisels, and similar implements should be dressed or replaced by others when they become burred or mushroomed. In heavy work, safety handles should be provided for holding the chisels, so that poorly-directed blows will not result in injury. Screens of burlap or other appropriate material should be provided, wherever needed, to protect nearby workmen from flying particles.

CLEANLINESS: Foremen should strive to promote personal cleanliness among the employees, not only because it is highly commendable for its own sake, but also because it reduces the danger of infection (or blood-poisoning) in case of injury. Warm water, soap, and towels should be provided in abundance, and the employees should be encouraged to use them. Cleanliness is of special importance in plants in which poisonous substances are used, and employees who have to deal with such substances should be required to make specially free and thorough use not only of soap and water, but also of hand brushes and tooth brushes, particularly before eating and before leaving the workplace. Furthermore, the workmen should never be permitted to eat their lunches in rooms where poisonous dust, fumes, or vapors are evolved during the manufacturing operations.

In some industries it is important to change the clothing throughout, upon entering or leaving the workplace, and to bathe the entire body before quitting work and putting on the street clothing. In such cases the foreman should see that the employees comply with the requirements faithfully

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and conscientiously. Lockers should be provided, when clothing must be changed in this way, because employees often attempt to evade the requirements in some measure, unless the safety and privacy of their possessions are assured. (See also NEATNESS.)

CLOTHING AND HAIR: Foremen should give attention to the clothing worn by employees, and persons who are operating machines or working around machinery should not be permitted to wear loose-fitting or ragged clothing. Women should be required to take special precautions in this respect, and should be advised to wear nets or caps on their heads, so that their hair may not be caught in moving parts of machinery. Employees should not be allowed to change their clothing, nor to dress their hair, near moving machinery of any kind, nor under revolving shafting. Rubber boots, or congress shoes fitting snugly about the ankles, should be worn by workmen handling molten metal, corrosive chemicals, hot fat, and similar dangerous liquids.

COMPRESSED AIR: No man should be allowed to work, in caissons or elsewhere, in an atmosphere having a higher pressure than that of the free outside air, without first passing a suitable medical examination to determine his fitness for such work; and if any man reports for work in an unfit condition, either from sickness or otherwise, he should not be allowed to enter the region of the high pressure. In particular, foremen should take special care to prevent examined men from transferring their identification checks to others who have not been examined, and who may not be in condition to safely undergo exposure to the increased pressure. (Substitutions of this kind are often practised by men who fail to realize the danger incurred, and they cause a great deal of sickness and trouble.)

Proper locks should be provided, in connection with work done under pressure, so that the pressure to which the men are exposed can be gradually increased or diminished, as the men go into the workplace or come out of it. The rate of variation of the pressure in these intermediate locks or chambers should conform, as closely as possible, to the rate that experience and experiment have shown to be best, under the prevailing conditions, and the men should be rigidly held to this regime. Hospital rooms or chambers, in which employees may rest or receive medical treatment *while under pressure*, should also be provided whenever the nature of the work makes them advisable.

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CONSTRUCTION WORK: The men should not be permitted to ride on material hoists, nor on loads or hooks, nor to slide down ropes, nor to expose themselves to unnecessary hazards of any kind, nor to engage in useless spectacular feats. The floors of a building under construction should be kept covered over as effectively as possible as the building goes up, temporary coverings being laid if the permanent flooring cannot be put in at the time. When planks are laid down to serve as floors or platforms, either in the building or upon scaffolds, they should fit tightly together so that tools and materials cannot fall down between them, and they should be placed so that they cannot tip up, when workmen step upon them or deposit materials upon them. Permanent openings in floors should be provided with effective guard rails and toe-boards, and all other openings should be kept covered over with planks as continuously as possible. Passageways, doorways, gangways, and workplaces in general should be protected from falling material by sheds or roofs. (See also Blasting, Chipping, Compressed Air, Elevators, Excavations, Floors and Passageways, Hoisting Machinery, Ladders, Laws and Ordinances, Nails, Railings and Toe-boards, Scaffolds and Stagings, and Wrecking.)

CONVEYORS: Workmen should not be allowed to climb over moving conveyors of any type, nor to walk or ride on them, and they should be specially careful when cleaning around or under conveyors, or oiling them. All work upon the conveyors should be done, so far as possible, when the machinery is stopped. Oilers should not be allowed to wear loose-fitting or ragged clothing. Conveyors, and the runways parallel to them, should be railed off or be effectively protected in some other way, and they should be well and substantially constructed. Stock or material should not be allowed to accumulate in excessive amounts at the discharge end of the conveyor. Conveyors outside of buildings should be covered in, because otherwise the stairways and runways alongside of them may become coated with ice or frost in winter, and cause workmen to slip and be injured.

CRANES: See HOISTING MACHINERY.

CUTS: See CLEANLINESS, and INJURIES.

DASH-POTS: See ENGINE ROOMS.

DEMOLITION: See WRECKING.

DEVICES, SAFETY: See GUARDS.

DIGGING: See EXCAVATIONS.

DISCIPLINE: Proper discipline is essential in every shop and factory, and foremen and superintendents should impress upon the employees the necessity for observing the rules and regulations that are in force in the plant. There should be no undue familiarity between foremen and employees, and orders and instructions should be given so that there can be no misunderstanding with regard to the authority of the foreman, nor with regard to the necessity of obeying him promptly and implicitly. Unnecessary harshness and severity should be carefully avoided, however, and special pains should be taken to establish and foster a feeling of mutual good will between the workmen and everyone in authority over them. (See RELATION OF THE FOREMAN TO THE EMPLOYEE, at the beginning of this booklet.)

DOCTORS: Every foreman should know the addresses of several of the nearest physicians, and should keep their telephone call-numbers posted in a conspicuous place, near his own telephone. This will avoid loss of time in looking up addresses after an accident has occurred, when the saving of a few seconds may be highly important. The list should contain a sufficient number of addresses to insure the finding of at least one doctor, at any hour. The doctor should be summoned without hesitation whenever he is needed, and also in every doubtful case, in which it appears likely that he might be of service. In large plants, and in all plants in which the processes are specially hazardous, a doctor should be permanently attached to the operating staff. (See also INJURIES, and SICKNESS.)

DOORS: All doors should be carefully inspected from time to time, to see that the hinges are strong and sound; and all hinges that are seriously defective should be immediately replaced by new ones. Exit doors that are used by employees should open outward. Means should be provided to hold doors open when this is desirable, and to prevent them from swinging closed. Large doors, in particular, should be arranged so that the parts of the hinges cannot become separated and allow the doors to fall. Doors with vertical lift should not be held open by placing sticks, boards, or metal rods under them, but should be secured by strong, permanent fastenings. When counterweights are used on doors they should be inclosed, or guarded in some other equally effective way. Doors at the top of a stairway should open toward the stairway, so that they cannot become jammed in case of fire or panic. A landing should also be provided on the stairway side.

DUST: Rooms in which dusty operations are carried on should be equipped with suitable ventilating systems, not only to safeguard the health of the workmen, but also because many kinds of organic dust are highly explosive when mixed with air in certain proportions. When practicable, each individual machine should be provided with an exhaust hood, and the dust should be drawn off through this hood by suction and deposited in a safe place outside of the building. In all plants in which fine, combustible dust is produced, the walls, floors, and ceilings, and all beams, window sills, and other lodging places upon which the dust may collect, should be cleaned with vacuum cleaners, or be brushed down frequently and carefully, and in such a way as to avoid stirring up the deposits more than necessary. In extreme cases, and especially if the dust is of a poisonous or irritating nature, suitable respirators should be provided, and the workmen should be required to wear them. (In plants in which combustible dust is produced in large quantities, so that there is danger of serious dust explosions, great attention should be paid to the protection of the plant from this hazard. Upon application, the Engineering and Inspection Division of The Travelers Insurance Company will be glad to send further suggestions, without charge, for the practical treatment of this problem.)

DYNAMITE: See Blasting.

ELECTRICAL APPARATUS: No persons, other than regular qualified electricians, should be permitted to handle electrical apparatus of any kind, nor to touch it in any way. Every man who is working upon high-tension conductors or apparatus should have an experienced assistant always at hand, to render aid in case of emergency. Rubber gloves should be provided for all electricians. The gloves should be regularly inspected, and should be immediately discarded if it is found that their protective value has been sensibly affected by reason of wear, or by being cut or torn, or in any other way. Safety belts should be provided for men working upon overhead lines, and dark-colored glasses should be furnished for men who are obliged to look at intensely brilliant arcs.

Generators, motors, switchboards, transformers, exposed wiring, and other similar equipment should be protected if they are within seven feet of the floor or a platform. When the voltage is 275 or more all current-carrying apparatus and equipment (except switchboards), within seven feet of the floor or a platform, should be covered or inclosed in such a way that no portion of a person's body can come in contact with any live part. Rubber mats should extend along the entire front of switchboards, and all current-carrying parts on the front of switchboards should be inclosed by insulating material or by grounded metal casings. There should be a clear working space of at least 3½ feet, measured horizontally, at the rear of each switchboard, and this space should be inclosed. Entrance to it should be through a gate or door in the inclosure, and this should be kept closed and signs should be posted forbidding the entrance of unauthorized persons. No tools, clothing, or material, nor any meters or other devices requiring attention every 24 hours or less, should be placed in the inclosure.

In addition to the foregoing safety provisions, when the voltage is 750 or more, all motors, generators, switchboards, transformers, switches, and bare live-wires should be situated in locked rooms or inclosures to which entrance may be had only by electricians or other specially designated persons.

The metal casings of transformers should be carefully grounded, and the grounding should be frequently tested.

Foremen should give full oral instructions to employees concerning specially dangerous apparatus, and should post conspicuous warning signs wherever these may be needed. The signs should be printed in several languages, if necessary, so that they may be thoroughly understood by all the employees. Foremen should be well informed regarding first-aid methods, and should know how to conduct effective artificial respiration work and how to deal with every emergency that is likely to arise, so that they may be able to render immediate assistance to men who may have received electrical shocks.

Wherever volatile, inflammable liquids (such as gasoline) are used, and wherever combustible or explosive dust or vapor may arise, the artificial light that is needed should be furnished exclusively by incandescent electric lamps, and the bulbs of these lamps should be protected by vapor-proof globes of standard make. It is often wise to adopt the further precaution of placing the lights (even when so protected) outside of the windows. Special care should be taken in making connections, and the electric wires should be thoroughly and effectively insulated at all points,

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and inclosed in metal tubes. All electric switches and fuses should be located in other rooms, where the air is never likely to be charged with any inflammable or explosive material. Electric motors or generators should not be used in a room where inflammable vapor or dust may occur, unless they are of the vapor-proof type, designed for special service of this kind.

ELEVATORS: A regular operator should be provided for every passenger elevator and every freight elevator, and he should never permit any other person to operate his car. He should never allow persons to scuffle or "fool" on the elevator, nor to conduct themselves in such a way that they may endanger themselves or others. The safe capacity of every elevator should be known, and employees should be positively forbidden to allow it to be loaded beyond this capacity, under any circumstances.

Locks should be provided for the hand cables or ropes of elevators that have this form of control, to prevent accidents that might be caused by taking the elevator from one floor by a person on another floor; or an interlock may be used that will prevent the operation of the hand cable if any shaftway door is open. An approved signaling system is also essential, arranged so that a signal may be given at each shaftway entrance.

The sides of the shaftway not used for entrance should be inclosed to a height of at least six feet; or, if automatic hatch cover doors are provided at the several floors, standard railings may be used if they are placed 12 inches from the edges of the shaftway opening. The entrances to the shaftway should be provided with approved gates or doors of the vertical sliding or horizontal sliding type. Swinging doors or collapsible gates may be made to afford adequate protection if they are specially equipped and locked, but they are not recommended. All doors or gates, whatever their type (except those that slide vertically), should be so arranged that they will be locked shut when not in use, and so that it will be impossible to unlock them from the outside of the shaftway except at the bottom landing.

The sides of the car not used for entrance should be inclosed to a height of 6½ feet, or to the cross head if this is less than 6½ feet above the floor of the elevator. When automatic hatch doors are not used the elevator should have a cover set back not more than six inches from the edge of the landing on the entrance side, and provided with a hinged section, also on the entrance side of the car.

Both car and machine limit stops, and approved safety devices should be installed, and should be examined and tested frequently, to make sure that they are in good working order. The cables and their fastenings should also receive frequent attention, and the door to the machine room should be kept locked, and no unauthorized person allowed to enter it. Ample light should be provided at every landing, so that the platform of the car may easily be brought level with the floor, and so that the freight can be handled without accident.

The safety of elevators depends very largely upon frequent and efficient inspection, and when defects are discovered they should be remedied immediately. The routine inspections should be made by some person definitely assigned to this work, and known to be competent and trustworthy; but additional periodical inspections should also be made at short intervals by experts, who have given special study to elevator problems. (See also HOISTING MACHINERY.)

EMERY WHEELS: The stands for emery wheels should be sufficiently heavy and rigid to prevent vibration, and they should be securely mounted upon substantial foundations. The bearings should be of proper length, to prevent heating and rapid wear, and they should be kept well lubricated and properly adjusted. The spindles should be large enough to prevent springing from the pressure of the work, and the wheels should fit their spindles closely without binding. They should not be forced upon the spindles, nor should they be loose. Every wheel should be carefully examined before it is mounted, and tapped lightly with a small hammer to detect cracks or other imperfections. The tool-rest should be rigid, and should be kept adjusted close to the wheel, to prevent the work from being caught. Wheels should be kept true and in perfect balance, and suitable tools should be provided for dressing them and maintaining them in proper condition. Each wheel should be inclosed by a substantial hood-shaped guard, to protect the men in case the wheel breaks while in use. The guards or hoods should also be connected with an effective exhaust fan, for the removal of the dust. The hoods should be made of substantial steel plate, rather than of cast iron, and they should be extended to cover the threaded end of the spindle, so that the operator's clothing cannot be caught upon it and wound up. The driving belts for emery wheels should be guarded to a height of at least six feet above the floor, and care should be taken, in every case, to see that

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the safe speed of the wheel is not exceeded. Substantial goggles should be provided for men working at grinding wheels, and the foreman should see that they are worn. Respirators should also be provided for the workers when a considerable amount of dust is present, or when the dust is of a poisonous or irritating or otherwise dangerous nature. (Further information in relation to emery wheels is given in a booklet called *Grinding Wheels*, which is published by THE TRAVELERS INSURANCE COMPANY. Copies of it may be had without charge. See also GRINDSTONES.)

ENGINE ROOMS: Employees should not be permitted to enter the engine room unless their work requires them to do so, and they should not be allowed to remain there after the duties that led them there have been performed. No person, other than those responsible for the operation of the engines, should be permitted to touch any valves or other parts of the mechanism, nor to approach any moving part, except as this may be necessary for the performance of work that is being done under the immediate personal supervision of the chief engineer, or of some other qualified person in authority. The flywheels of engines should be guarded by substantial railings, made preferably of brass or iron pipe; and when a railing is less than 15 inches from the spokes of the flywheel it should be at least 5 feet high (except where the top of the wheel is less than 5 feet above the floor), and the space between the rail and the floor should be covered in with substantial wire netting or steel plate. Toe-boards should also be provided to prevent tools and other objects from coming in contact with the wheel, or falling into the wheel pit. The storing of oil cans, tools, waste, and other articles inside of the railings, and the hanging of clothing upon the railings themselves, should be prohibited, and employees should never be permitted to go inside the railings, for any purpose whatsoever, while the engine is running. The main driving belt should be guarded in accordance with the suggestions under BELTING, page 10.

The ladders and steps that often occur about large engines should be railed, and the stagings or platforms to which they lead should also be provided with railings and toe-boards. All walks for oilers should be railed, and the governor balls should be guarded when they are near the oilers' walks or any passageway, or when they are so located that the engineer must go near them in the regular performance of his work, while the engine is running. When the back end of the piston rod extends through the cylinder head, the space that it traverses should be railed off or otherwise inclosed, and all other dangerous moving parts of engines should be guarded in a similarly effective manner.

The dash-pots on Corliss engines should receive the same care and attention as the governor. They should be kept oiled and properly adjusted, so as to give the correct cut-off and have the full amount of drop, and to work in harmony with the governor in the control of the engine. Careful attention should also be given to the packing of the valve stems, because if this is too tight the valves may stick, thereby delaying the cut-off and causing the engine to speed up.

An independent speed-limiting device, or "safety-stop", should be attached to every engine, to shut off the steam in case the governor fails to operate properly; and devices of this kind should be tested frequently, to make sure that they are in good working order. Electric push-buttons, for quickly stopping the engine in case of emergency, should also be installed throughout the plant. The safe speed of every flywheel should be known, and this speed should never be exceeded. The engine should never be left unattended, while it is in motion; and if the engineer is obliged to leave the engine room temporarily, some other competent and responsible person should be delegated to serve in his place during his absence, to meet any emergency that may arise.

Mats of rubber or fiber, or special non-slip surfaces of abrasive metal, should be used on the most frequented parts of engine-room floors, and in all specially dangerous places. Engine rooms should be well lighted, and should be kept in a neat and orderly condition.

All parts of the engines should be frequently and thoroughly inspected, all broken or defective parts should be immediately repaired or replaced, and the various appliances in and about the engine room should be kept in good working order at all times.

EXCAVATIONS: Careful supervision is essential to safety in connection with all excavating operations. The sides of excavations and the walls of adjoining buildings should be substantially shored up whenever there is the least danger of the caving-in of the earth, or of the fall of the walls. All trenches and other openings in the ground should be guarded by barriers during the day, and by lights in addition at night; and the workmen should not be permitted to leave such openings unguarded, even for short periods.

The number of men at work in a trench or excavation at any one time should be limited, so that there will be no likelihood of their striking one another with picks or other implements. When it is necessary to resort to blasting in connection with excavation work, the counsel given above, under the heading of Blasting, should be faithfully followed. Steam shovels, and other mechanical devices used in excavating, should be manned by experienced operators, and all the dangerous parts of these appliances should be well guarded. (See also Hoisting Machinery.)

EXPLOSIVES: See Blasting.

EYES: Foremen should watch for evidences of nearsightedness or other eye-troubles among the employees over whom they have authority, and all persons whose eyesight is imperfect should be required to consult a good oculist, or a competent physician who thoroughly understands the eye. It is not sufficient for them to merely buy spectacles from irresponsible venders. Their eyes should be properly examined, so that the exact nature of the trouble may be determined.

Attempts to remove foreign objects from the eye by means of a toothpick or a dirty handkerchief often result in infection or loss of sight.

Therefore, all injuries to the eye, even if the are slight, should be promptly treated by a competent physician. (See also GOGGLES.)

FANS: Fans used for ventilating or for othe purposes should be guarded, by wire-mesh nettin or otherwise, so that loose clothing cannot b drawn into the blades. They should never b cleaned while in motion, nor be oiled while i motion unless the oil cups are well away from th moving parts.

FIRE PRECAUTIONS: All factories, shops and other buildings in which men and women ar employed should be provided with a sufficien number of fire escapes of approved design. Thes should be substantial in construction, and the should be kept in good repair, and free from obstructions of every kind. Employees should no be permitted to use them for storage, nor as resting place for flower pots. Hose pipes sprinkler pipes, and portable fire-extinguisher should be installed wherever necessary, an plentiful supplies of dry sand or sawdust should be at hand wherever gasoline or other light, inflammable oils are used. (See GASOLINE.) Vats and other similar receptacles containing highly-inflammable substances should be provided with closely-fitting covers, which should be kept closed as much as possible. The covers, when open, should be held by fusible-link catches, so that they will shut automatically in case of fire.

Each foreman should organize the employees of his department into a fire brigade, and should assign a definite duty to every individual. Fire drills should be held regularly at least once a month, and they should also be held unexpectedly, at reasonable intervals. Foremen should see that these drills are taken seriously by the employees, and that every person plays his or her part faithfully. (See also ELECTRICAL APPARATUS, FLOORS AND PASSAGEWAYS, STAIRS AND STAIRWAYS, and PANICS.)

FIRST AID: See INJURIES.

FLOORS AND PASSAGEWAYS: All floors should be strong enough to support their loads safely and with a large factor of safety. In figuring up the load, the weight of the work-people, and of the greatest amount of stock, material, and finished and unfinished product should be included, as well as the weights of the machinery and that of the floor itself. If there is any doubt whatever of the floor or its supports being strong enough, it should be stoutly and effectively shored up. If the load to be carried is likely to change rapidly in amount or in position, or if the machinery is of such a nature that it is likely to jar the floors or the walls of the building, the factor of safety of the flooring and its supports should be at least twice as great as might be sufficient if the load were a dead or stationary one, causing no vibration of the building. No more materials or finished products should be stored upon or above the floors on which work is done, than the efficient conducting of the work may require, unless special allowance is made for this purpose in laying out the floor space, and in building and supporting the floors.

The floors should be sound, and free from holes and from weak, uneven, or springy places. They should also be kept free from splinters, loose or projecting nails, loose boards, rope, cord, and slippery substances such as grease and oil. Special care should be taken to keep the floors in good repair around shaftways and other similar openings, and in all passageways. Temporary openings in floors should be effectively guarded, and they should be closed up or covered over again, as soon as possible. Floors around dangerous machinery should have a slip-proof surface of abrasive metal, rubber, or other approved material.

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Passageways and other places that are frequently used should receive special attention, and they should be kept scrupulously free from obstructions of every kind. Passageways, especially in the vicinity of machines and dangerous operations (such as the handling of hot fat or melted metals), should be wide enough to let the men keep well away from danger, and to enable them to do their work in the safest way possible. Materials and finished or partly finished work should be stored so that they do not encroach on the passageways, and trucks should never be left standing in them. It is recommended that a conspicuous "dead-line" be painted on the floor along each side of every passageway, to mark the limit of the space that must be left unobstructed. All passageways should be kept well lighted at all times. (See also FIRE PRECAUTIONS.)

FOREIGNERS: Foremen should take special care with foreign-born employees who do not understand English well, and should see that they know exactly what to do, and that they thoroughly understand the dangers of their work. Whenever necessary, intelligent and trustworthy interpreters should be provided, with a good command of both languages, and enough technical knowledge to clearly understand the things they are to explain. Care should be taken to see that every rule and order is thoroughly understood, both by the interpreter and by the workers themselves. (See also INSTRUCTION, and RULES.)

FREIGHT ELEVATORS: See ELEVATORS, and HOISTING MACHINERY.

FUMES: See PAINTING, and VAPORS.

GAS: Employees should not be permitted to use open-flame lights when searching for leaks of illuminating gas, or inflammable gas of any other kind. Only incandescent electric lamps should be used for this purpose, and these should be effectively guarded against breakage, by inclosing them in stout wire cages or vapor-proof bulbs. If the leakage is bad, the gas supply should be shut off as soon as possible, and the room should be thoroughly ventilated before any one enters it. The windows can often be opened from the outside of the building, and if they cannot be opened in any other way it is often advisable to break them. In serious cases the assistance of experienced men from the local gas company should be sought, if this course is practicable. (See also VAPORS.)

GASOLINE: Foremen should exercise strict supervision with regard to the use, handling, and storage of gasoline. Smoking and the use of open-flame lights or matches in the vicinity of gasoline, or of tanks, barrels, or cans which have recently held gasoline, should be strictly prohibited, and the rules against these practices should be rigorously enforced. When receiving large quantities of gasoline the tank car or tank wagon should be unloaded as far as possible from buildings, piles of lumber, and other inflammable material. The filling connection for the main-supply tank should be located so that it will not be necessary to bring the car or wagon near the main buildings, and the ground around the filling connection should slope in such a direction that the gasoline, in the event of an accident while unloading, would flow away from the buildings rather than toward them. All piping should be inspected frequently for the purpose of discovering leaks, and all valves, cocks, and connections of every kind should be kept tight. Chemical fire-extinguishers, or a plentiful supply of sand or sawdust with a pail or a broad shovel for handling it, should be kept in every room where gasoline is stored or used. Sand (or sawdust) blankets the flames and puts them out by excluding the air; but employees should be cautioned against trying to extinguish gasoline fires by the use of water, because this will only serve to spread the flames. The burning gasoline floats on the water, and is carried about with it.

When belts pass through rooms in which large quantities of gasoline are used or stored, the pulleys over which they run should be grounded to prevent the generation of static electricity, because electric sparks ignite gasoline vapor very readily. Gasoline that has been spilled on the floor, or has leaked out upon it, should not be permitted to remain there, but should be promptly removed. It should never be allowed to run directly into the sewer, however, but should first pass through a separator, or be collected in removable catch-pans placed in the sumps of the floor, and disposed of in some other safe way. In all places in which gasoline is used, the counsel given in the last paragraph of the section on ELECTRICAL APPARATUS should be faithfully followed. (See also FIRE PRECAUTIONS.)

GEARS: All exposed gears should be entirely inclosed by wire-mesh screens, or by metal or wooden housings; or if there is no spoke hazard, band-guards may be provided, with side flanges extending inward beyond the root of the teeth. The guards should be removable, to facilitate inspection and oiling; but workmen should not be allowed to take them off unnecessarily, and the machines should never be set in motion unless the guards are in their proper places. (See also Guards.)

GLASS: See Rubbish.

GOGGLES: Suitable goggles or eye-protectors should be provided for all employees engaged in chipping and grinding operations, or in handling molten metal of any kind; and the foreman should see that they are worn by the employees, wherever they are needed. Many of the goggles that are sold for this purpose are flimsy and altogether unsatisfactory. It pays to buy substantial goggles, at a higher price, not only because they are more effective, but also because they are more durable. The lenses should be of strong, clear glass, and the frames should be light in weight and be adjustable, so that they can be shaped to fit the wearers. They should also have side screens, and the construction should be such that fragments of glass will not be likely to enter the eye, if a lens is broken while in use. Dark-colored spectacles or goggles should be furnished for electricians, welders, foundry furnacemen, and others who may have to look at intensely brilliant lights. (See also Chipping, Eyes, and Sanitary Conditions.)

GOVERNORS: See Engine Rooms.

GRINDING WHEELS: See Emery Wheels, and Grindstones.

GRINDSTONES: The mounting of grindstones should be carefully looked after by foremen, and the use of wooden wedges to center the stones, or to secure them to their axles, should not be permitted. Cracks in grindstones are often caused by driving such wedges in too tightly, or by their swelling upon becoming wet after they are driven. Flanges of good size should be used to support each grindstone and connect it rigidly to its arbor, and after the stone is centered the space around the arbor may be filled with cement or lead. Stones that run out of true, through uneven wear or bad adjustment, should be carefully trued up. The safe speed of a grindstone depends upon the nature of the stone composing it. Ohio and Huron stones are the most widely used varieties. An Ohio stone should be run with a rim velocity not exceeding 2,500 feet per minute, while Huron stones, if sound and in good condition, may be allowed a rim speed of 3,000 feet per minute, and in certain special cases the limit for a Huron stone may be increased to 3,500 feet per minute. When stones of unknown origin

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and material are used, the speed should be limited to 2,500 feet per minute.

GUARDS: All exposed gears, pulleys, belts, and shafting should have substantial and effective guards of wire mesh, sheet metal, or wood, designed and installed so as to thoroughly protect the employees from all possible danger. (See also Belting, Engine Rooms, Fans, Gears, Pulleys, and Shafting.) Similar guards should also be provided about all other dangerous moving parts that are within six feet of the floor or working platform. Belts that run over passageways or workplaces should be guarded so that they can do no harm in case they should break. Guards may be made removable, to facilitate the inspection, oiling, or repairing of the various parts of the mechanism; but they should never be taken off except for good and sufficient reasons, and then only by the foreman's special order, when the machinery is stopped. Machines from which the guards have been removed for any reason, should not be operated until the guards have been replaced. Employees often remove guards, either because they are not accustomed to them or because they believe that the work can be done better or more expeditiously without them. This practice should be strictly prohibited, and foremen should be watchful, at all times, to detect such offenses. All guards should be constantly maintained in good condition.

HAIR: See Clothing and Hair.

HOISTING MACHINERY: All the dangerous moving parts of cranes, derricks, winches, and other forms of hoisting machinery should be effectively guarded. Overhead traveling cranes should have substantial walks, and these should have toe-boards and strong railings along their entire length. To give access to such cranes, stairs or stationary iron ladders with hand-rails should be provided, leading to platforms of ample size; and operators should not be permitted to climb up to their cranes on columns or on makeshift ladders of any kind. Fenders, guards, or brushes should be attached in front of crane trucks to give warning to persons who may be working on or near the runways, and each traveling crane should have a foot gong. All traveling cranes should be equipped with spring bumpers, and should have adequate brakes for both the traveling and the hoisting mechanism. Suitable stops should be placed at each end of the runway. All wires on electric cranes should be properly insulated, and the operator of a crane of this type should always open the main switch before leaving his cab. A tool box should be located on each crane, or beside the runway, and the tools should be kept in it when not in use. Every possible precaution should be taken to prevent tools, supplies, or materials from falling from any part of the crane or runway.

Limit switches should be provided on all hoists, wherever this is practicable, and all sheave-blocks should be inclosed. Riding on loads or crane hooks, and sliding down hoisting ropes, should be prohibited. Unauthorized persons should not be permitted to go upon runways or into crane cabs, nor to operate cranes, nor to tamper with the cranes in any way.

Hoisting apparatus of every kind should be inspected frequently and thoroughly, and all parts that are defective in any way should be promptly repaired or replaced. A safe and adequate system of signaling should be adopted, and this system should be rigidly adhered to, in order to avoid any possibility of misunderstanding. Careful attention should be paid to the guying of derricks and other similar apparatus, and also the securing of the feet of their masts. The guys should be of the proper size and strength, and they should be sufficient in number, and be well placed and firmly secured at each end.

Every foreman in charge of hoisting operations should have a thorough knowledge of chains, slings, wire ropes, and fiber ropes of all kinds and grades, and should know the various purposes to which each is adapted. He should also know the safe working strengths of the various sizes that he has in use, and the minimum sizes of the sheaves over which the wire ropes may be safely run. Wire rope that is exposed to the weather should be treated from time to time with a good preservative dressing, and ropes of all kinds should be rejected *and destroyed* when they have deteriorated to such a point that it is no longer safe to use them. All ropes, chains, cables, blocks, slings, and other portable appliances and accessories that are used for hoisting, or that might be so used, should be kept under lock and key by the foreman when not in use, who should see that they are maintained in good condition. When any such appliances or accessories are needed, he should give them out with due regard to their strength and condition, and the nature of the work that is to be done; and he should see that they are promptly returned to him when they have served their purpose.

Chains and hooks should be carefully inspected at regular intervals, and they should also be annealed from time to time by competent workmen

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who thoroughly understand the annealing process. All chains and hooks should be numbered so that they can be readily identified.

Wire-rope slings, when well made, are preferable to those composed of chains. Chain slings should never be crossed when placed around the load, and care should be taken to see that chains are not twisted when used as slings. No sling should ever be allowed to rest directly against the corners of heavy, rigid materials, such as steel beams and blocks of cut stone. It should be protected by placing pieces of wood or other slightly yielding substance at these points. Slings should be placed about the load carefully and as symmetrically as possible, so that the load will not slip, tip, or overturn.

A sling should always be long enough not only to surround the load it has to support, but also to leave a considerable space between the sling and the upper surface of the load. The oblique parts of the sling, which lie above the load and join it to the hook (or to the point where the suspension first becomes vertical) should never be so flat as to make an angle of less than 45 degrees with the ground. This precaution is highly important, but it is often overlooked or neglected, because the men often do not realize that the stress on the ends of a sling is greater, the flatter (or more nearly horizontal) they lie. When the ends are inclined at an angle of 45 degrees, the stress upon each of them is about 41 per cent. greater than it would be if the ends were vertical; and if the sling is so short that it barely goes around the load and has but little slack, the stress upon it may be very great indeed.

HOOKS: See Hoisting Machinery.

ICE: Ice should not be allowed to collect over doorways, nor to hang from the eaves of buildings over windows or passageways or in other similar places. Walks, platforms, and runways should be kept sanded when covered with ice, and should be freed from the ice as soon as practicable. Special care should be given to inclined walks or runways in this respect.

IDLING: See Unemployed Persons.

INJURIES: All injuries should receive prompt attention, even if they are trivial. They should be treated at once, and they should also be carefully recorded, the date and the nature and extent of the injury being entered in a record book. Serious cases of blood-poisoning often occur, as the result of infection, in small wounds that have

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been neglected. Foremen should impress upon the employees the importance of reporting all injuries, however slight, either to the foreman himself or to some other person who may be designated to attend to matters of this kind. First-aid outfits should be provided, and one or more persons should be thoroughly instructed in the use of them; but every injury should be referred to a skilled physician, as soon as possible. The first-aid outfits should be used merely for giving temporary relief to the injured person or for sustaining life until the physician is available. A great deal of harm is often done by the well-meant but unskilled treatment that injured persons receive from fellow-employees, and it is therefore highly important that the person who gives the preliminary treatment should be fully qualified, and that he should thoroughly understand the ways in which he can do harm, as well as those in which he can do good. Injuries to the eye should receive special attention, because serious consequences often result from the neglect of such injuries. (See also Cleanliness, Doctors, and Eyes.)

INSPECTIONS: Frequent inspection of all machines and of all parts of the plant is essential. In large plants the entire time of at least one man may profitably be given up to this work. The men selected for inspection service should be competent and trustworthy, and they should be authorized to order immediate repairs or to take such other action as may be necessary, whenever dangerous conditions are discovered. Additional inspections of the entire plant should also be made, periodically, by experts who have made a special study of work of this kind, and who have visited many other plants, and are, by reason of their experience, skilled at detecting and remedying dangerous conditions.

INSTRUCTION: Foremen should see that every employee thoroughly understands the machine at which he works, and knows the dangers of his calling. Special attention should be given to those who do not understand English, or who understand it very imperfectly. (See FOREIGNERS.) Any employee who is shifted to a new machine should be fully instructed with regard to the machine and its dangers, and efficient and profitable work should not be required or expected of such an employee until he has had a reasonable time to acquire sufficient skill in his new position to perform his work safely. Every foreman should issue, from time to time, such general and special instructions as his experience and observation may suggest for promoting safety among the employees under his charge.

INTERPRETERS: See Foreigners, and Rules.

INTOXICATION: Intoxicated persons should not be permitted to work about any kind of machinery nor to loiter in the neighborhood of it, nor about any place of danger. This advice is given not only for the benefit of the men who are intoxicated, but also for the protection of others from the consequences of the acts of such persons; and it applies not only to cases of gross and evident intoxication, but also to cases in which the persons under consideration are affected only to a slight degree, yet sufficiently to raise the question of their ability to perceive danger to themselves or to others, and to avoid it promptly and certainly. Cases of this kind often arise in which the foreman must exercise nice judgment in order to maintain discipline and insure safety to all, without giving offense or subjecting any person to needless humiliation. (See also Sickness, Alcohol, and Wood Alcohol.)

JACKS: Lifting jacks should be kept in good condition, and should be inspected frequently.

Jacks should be used for lifting only,—horses, trestles, blocks, or other similar devices being provided to sustain the load after it has been raised to the desired height by the jacks. Foremen should personally supervise the lifting of heavy loads by means of jacks, and should see that the jacks are placed firmly and in the proper positions.

JAPAN: In handling japan varnish the same precautions should be taken that are recommended for Gasoline and Lacquer. The ovens should be carefully examined, at least as often as once a week, and all necessary repairs should be promptly and thoroughly made.

LACQUER: Lacquer rooms are subject to severe fires or explosions, on account of the inflammable nature of the liquid that is used. Special care should therefore be taken to eliminate all open flames, and to provide exhaust hoods wherever they may be needed, to remove the vapors that are produced. The main supply of lacquer should be stored in an outside, detached building, and the quantity present in the workroom should never be greater than is needed for half a day, or a day. No matches should be taken into the lacquer room. The artificial light that is required should be obtained exclusively from incandescent electric lamps, and the lamps and their wires and connections should be safeguarded as explained in the last paragraph of the section on Electrical Apparatus, in this booklet.

LADDERS: When stairways are not provided for reaching elevated positions to which employees may have to go, permanent iron ladders should be used wherever possible, and back bars should be provided for them, whenever these would be advantageous. When a permanent ladder is placed vertically, and attached to the side of a building or other structure, a space of at least eight inches should be left between the wall and the rungs of the ladder, to insure a good foothold. Wooden ladders should be made of sound, straight-grained material, securely fastened together. Spruce should be used for the side bars, and shaved oak for the rungs. The sides and rungs should be free from slivers and projecting nails or screws, and the use of broken, weak, or rickety ladders, or ladders with missing rungs, should be forbidden.

Every ladder should be long enough for its upper end to extend at least four feet above the platform or landing to which it leads, so that the workmen may get a good hold upon it before descending. Ladders should be securely fastened at the top, so that they cannot slip sidewise, nor be bodily overthrown. They should also be made equally secure at the bottom, and they should be equipped with safety feet whenever this appears necessary to prevent them from slipping. Long ladders should be stiffened by props or braces, midway of their length, to prevent them from bending or swaying. Men working on ladders should not be permitted to carry loads that will interfere with the free use of both hands for holding to the ladders. Ropes and pulleys should be provided, whenever necessary, for raising loads for which the men would otherwise have to use their hands.

When joining two ladders together to make one long one, special care should be taken to make the joint between the two as stiff and strong as possible, and ladders that are spliced in this way should be braced at the joint, to reduce the bending stress at this point to a minimum.

Stepladders should be kept in good condition, and it is advisable to cover their treads with rubber or some other non-slipping material.

LAWS AND ORDINANCES: Every foreman should know all the general and local laws and ordinances that relate to his part of the work, and should see that these laws and ordinances are strictly observed and faithfully followed.

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LIGHT: The entire plant or workplace should be well lighted. The light should be of proper intensity, and it should also be well distributed. Incandescent lamps and other artificial light-sources should be fitted with proper reflectors, and should be shaded, when necessary, so that they will not shine directly into the eyes of the employees. Special attention should be given to the lighting of passageways, stairways, and all places where unusual or hazardous conditions exist. (See also Eyes, and Goggles.)

MACHINES AND MACHINERY: All machines should be effectively safeguarded. They should also be properly spaced, so that the workers may move about the machines at which they are employed without danger of injury from other machines in the vicinity, and without being too closely confined between their own machines and the walls or supporting columns of the building. Hand-levers, belt-shifters, and other devices for starting and stopping machines should be so arranged that they can be locked in the "stop" position, to prevent the machines from being accidentally or unexpectedly started. Machine operators should be cautioned against being inattentive to their work, and they should not be allowed to look about the room nor out of the windows, nor to talk with other employees, while standing close to machines in motion. (See BELTING, CLOTHING AND HAIR, CONVEYORS, ELECTRICAL APPARATUS, EMERY WHEELS, ENGINE ROOMS, FANS, FOREIGNERS, GEARS, GRINDSTONES, GUARDS, HOISTING MACHINERY, INSTRUCTION, JACKS, OILING, PULLEYS, and SHAFTING.)

MATERIALS, STORAGE OF: See STORAGE.

METAL SCRAP: See RUBBISH.

NAILS: Employees should be strictly forbidden to leave nails lying about on floors and benches, and special care should be taken to enforce this order with regard to nails that are rusty and dirty. Nails projecting from planks, boards, and wooden objects of every other kind should be immediately removed or driven in, or should be bent over and have their points hammered in. If time cannot be spared to attend to the nails immediately, the boards, planks, or pieces in which they occur should be laid up in orderly piles with the points of the nails turned downward; but as soon as these piles can receive attention, the nails should be removed or treated as indicated above. Injuries from nails, even though comparatively slight at the start, are often followed by blood-poisoning or lockjaw, and they should therefore receive prompt medical attention.

NEATNESS: Neatness and orderliness should be encouraged among the employees in every practicable way, because a general air of neatness about the workplace fosters self-respect among the employees, and promotes efficiency and safety in a marked degree. Spitting on the floor is unsanitary, and it is also exceedingly unpleasant to persons who do not practise it. Foremen should see that it is discontinued entirely. Special care should be taken in connection with all sanitary arrangements, to keep them in the best condition possible. Neatness in this respect is conducive to health, comfort, self-respect, and general good feeling among the employees. Foremen should therefore deal severely with carelessness in this direction, and with wanton disregard of the ordinary decencies of life. (See also CLEANLINESS.)

OILING: One or more careful and responsible persons should be selected to attend to the oiling of the machinery throughout the plant. Oil cans with long necks should be provided, and the oilers should wear closely-fitting clothing with no torn, loose, or ragged ends. Oiling machinery while it is in motion should be strictly forbidden. Whenever practicable, walks for the use of the oilers should be provided beside long lines of shafting, and these walks should have substantial hand-railings. Automatic lubricators should be used wherever practicable, and these should be inspected, periodically and systematically, to make sure that they are feeding properly. The ladders that are used by oilers should be light in weight, for convenience in carrying; but they should be substantially constructed, and should be provided with safety feet to prevent slipping.

PAINTING: Many modern paints and preservative coatings contain benzine or "banana oil" or other substances, the vapors of which are likely to intoxicate or poison the men if the work has to be done in a confined space. In such cases special attention should be paid to the ventilation of the workplace, and the men should be provided with respirators or with oxygen apparatus, whenever aids of this kind appear to be desirable. (See VAPORS, and VENTILATION.)

Employees using paints containing lead, copper, or other poisonous constituents, should be required to pay great attention to their own personal cleanliness, and facilities should be provided to

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enable them to effectively remove all traces of the material from their hands and faces, before eating and before leaving the workplace. (See Cleanliness.)

Men who have to work in elevated places should thoroughly understand the handling of painters' stagings and boatswains' chairs, and safety belts with life-lines attached should be provided for those who have to work in elevated places where it is not practicable to use stagings or chairs. (See also Safety Belts, and Scaffolds and Stagings.)

PANICS: To avert panics as far as possible, the employees should be frequently warned of the consequences of needless haste in time of danger; and the effectiveness, safety, and capacity of the fire escapes should be explained to them from time to time, so that it becomes a familiar story that they will not be likely to forget when the moment of danger comes. Special pains should be taken with new employees in this respect. In the event of a threatened panic, certain of the male employees, selected in advance for their coolness, judgment, size, and strength, should take immediate command of each exit, and prevent crowding there, as far as possible. These men should also reassure the other employees as much as possible, by pointing out that all will escape from the building, safe and sound, if they proceed in an orderly manner. Periodical fire drills are also valuable in connection with the control of threatened panics. (See FIRE PRECAUTIONS.)

PASSAGEWAYS: See CONSTRUCTION WORK, and FLOORS AND PASSAGEWAYS.

PHYSICIANS: See DOCTORS.

PLATFORMS: As a general rule, platforms that stand more than six feet above the level of the ground or floor should have standard hand-railings and toe-boards on all open sides. Exceptions to this rule are small platforms for motors having standing room less than 18 inches in width; shelves used only for storage; oiling runways 18 inches in width with a standard railing on one side; and freight platforms used for loading cars or wagons.

The floors of platforms should be constructed of sound planks or boards, or of metal floor plates, and these should be placed closely together to prevent tools and other objects from falling through between them. Access to platforms should be preferably by stairways provided with

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hand-rails, or by permanent ladders firmly secured to the platforms. Care should be taken to prevent the men from overloading the platforms by depositing excessive quantities of material or supplies upon them.

POISONS: See Chemicals, Cleanliness, Painting, Vapors, and Wood Alcohol.

PULLEYS: All exposed pulleys should be effectively guarded by railings or by substantial wire-mesh screens, in accordance with the recommendations in connection with Belting, on page 10. All pulleys should be frequently and thoroughly inspected. This is particularly important in connection with pulleys made of cast iron, because these are likely to develop cracks either in the arms or in the rim. The hammer test should be applied at the time of the inspection, and any pulleys that are found to be defective should be repaired or replaced. Pulleys should never be operated with pieces broken out of their rims or arms.

RAILINGS AND TOE-BOARDS: Railings around floor openings, and around pits, platforms, and elevated and dangerous places in general, should be strong and smooth, and if they are made of wood they should be free from cross-grained places and bad knots or other serious defects. If pipe is used, it should be 1¼ inches inside diameter, or larger. The uprights or posts should be spaced not more than 8 feet apart. The railings should be 42 inches high, measured to their upper edges, and they should be supported (and braced, if necessary) so as to resist effectively any shock that may be thrown upon them. There should be a second rail midway between the upper rail and the floor, to prevent persons or objects from falling under the top rail. Toe-boards should be set tight to the floor, and they should be not less than three inches, and preferably six inches or more in height, according to the nature of the protection that is to be afforded. The purpose of toe-boards is mainly to prevent tools and materials from falling down, but in some cases they are also needed to prevent persons from falling under railings.

RAILROAD DANGERS: Foremen should caution employees against walking upon railroad tracks that may be near the workplace, and against walking or standing, needlessly, between the rails of spur tracks in the yard of the plant. When a door opens directly upon a railroad track, a substantial railing should be placed just out-

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side of the door, to prevent persons from walking directly out upon the tracks; and similar railings should be placed at the corners of buildings when the tracks are dangerously near. If the space between a building and a neighboring track is so small that a person standing there might be crushed by a passing train, it should be floored over by boards or metal plates, inclined at such an angle that it is impossible for anyone to stand or walk upon them.

When stock or material is stored near a railroad track there should be a clearance of at least six feet between the track and the piles. If for any reason it is impossible to obtain this amount of clearance, conspicuous warning signs should be placed at both ends of the piles, to prevent persons from passing between them and the tracks.

The gang-planks used in transferring materials from cars on sidings directly into a building, should be kept in good condition, and the hand trucks should be kept in good repair also. The foreman should personally supervise the work of loading cars with dangerous chemicals, explosives, or highly-inflammable materials, and he should make sure that the boxes or packages are properly stowed, and effectively secured against being thrown about by the motion of the train.

RESPIRATION, ARTIFICIAL: See ARTIFICIAL RESPIRATION.

RESPIRATORS: Respirators of approved design and construction should be provided for employees engaged upon work in connection with irritating, poisonous, or otherwise harmful dust, fumes, or vapors, such as those given off by acids and chemicals, or by grinding or polishing wheels, or in other ways. Foremen should also see that these respirators are worn by the employees, wherever they are needed. (See also SANITARY CONDITIONS.)

ROOFS: Safety belts and lines should be provided for workmen engaged in repairing steep roofs, and the foreman should see that these are worn. Flat roofs, upon which employees and others are allowed to go, should have guard railings on all sides, and these railings should be placed at least six feet back from the edges of the roof. Employees should be forbidden to throw articles from roofs, and no loose material should be left on roofs, that could be blown off and injure persons below.

ROPE: See HOISTING MACHINERY, and ELEVATORS.

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RUBBISH: Refuse and rubbish should not be allowed to accumulate in passageways, in dark corners of rooms, nor in other places. This applies particularly to broken glass and earthenware, metal scrap, loose nails, and pieces of board, rope, and wire. Whenever practicable, stout gloves should be provided for workmen engaged in handling rubbish.

RULES: Safety rules and regulations, adapted to the needs of each particular workplace, should be drawn up and brought to the attention of the employees in some effective way. Signs, placards, or pamphlets may be used, according to the circumstances; but the signatures of all employees should be obtained, to show that they have read the various safety rules, and that they understand them thoroughly. All rules and regulations should be clearly expressed, so that they cannot be misunderstood, and they should be issued in appropriate foreign languages, as well as in English, if any considerable number of the employees do not understand English perfectly. Interpreters should be freely used, wherever necessary, and foremen should never forget that some of their employees may not be able to read even the languages that they speak. Special care should be taken to see that deaf, maimed, and otherwise defective employees fully understand the additional danger to which they are exposed by reason of their infirmities.

All rules that are given out should be strictly enforced, and foremen should themselves obey every rule faithfully. Any rule that has become obsolete or unnecessary should be crossed off or erased from such cards or pamphlets as may have been given out, and also from signs and placards that may have been posted about the workplace. To leave an old and discarded rule upon pamphlets, cards, or signs, without enforcing it, tends to encourage laxity with regard to other rules that are still important. (See also FOREIGNERS, INSTRUCTION, and SAFETY ORGANIZATION.)

RUNWAYS: Runways should be substantially built, and they should be effectively supported and braced to prevent bending or swaying. When more than six feet above the ground they should be substantially railed, and the railings should extend along both sides, unless one side is sufficiently protected by a wall, or otherwise. Standard toe-boards should also be provided. Inclined runways should have cleats nailed to them at intervals of from 8 to 10 inches to afford a secure foothold; and when covered with ice or snow they should be sanded, and the ice or

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snow should be removed as soon as possible. The use of single-plank runways for wheelbarrows should be forbidden.

SAFETY BELTS: Safety belts, with life-lines attached, should be provided for window cleaners and for men working on roofs and smoke-stacks, or on electric transmission lines, or engaged in other similar work at a considerable height. Foremen should also see that these belts and life-lines are kept in good condition, and are faithfully worn. (See also Painting, and Windows.)

SAFETY DEVICES: See Guards.

SAFETY ORGANIZATION: A well organized safety department is of great value in reducing accidents in every plant. The same general scheme is applicable in both large and small plants, but naturally the larger one will require the more elaborate and extensive organization in order to carry on the work effectively. It is not feasible, in this place, to give even an outline of the methods employed for establishing and conducting a safety organization, but the subject is treated most comprehensively in a special booklet published by The Travelers Insurance Company, and entitled *Organization in Safety*

Work. Copies of this publication will be mailed free of charge, to foremen and other persons i authority.

SAFETY STOPS: See Engine Rooms.

SANITARY CONDITIONS: Fresh air, good light, pure drinking water, and clean and orderly workrooms are important features in all manufacturing plants. They greatly promote efficiency and safety, and foremen should do everything possible to insure good conditions in these respects. A plentiful supply of hot and cold water and soap should be provided, and a sufficient number of clean towels should also be furnished. (See also Cleanliness, and Neatness.)

Care should be taken to avoid the transmission of disease by the promiscuous use of goggles, respirators, apparatus for promoting artificial respiration, and other devices that are likely to be brought into intimate personal contact with various employees in succession. So far as practicable, appliances of this nature should be assigned to definite individuals, for personal use only; and when they have been used by one employee they should not be given out to another until they have been effectively sterilized or disinfected.

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SCAFFOLDS AND STAGINGS: The work of constructing scaffolds and stagings should be carefully and thoroughly done, and nothing but first-class, selected material should be used for them. The material should be ample in size and abundant in quantity, and the parts should be strongly fastened together with a sufficient number of high-grade nails of good size, or with effective clamps. The ropes that support swinging scaffolds should be inspected daily, and swinging scaffolds such as are used by painters and for small work, and which are to support live loads, should be tested (before anyone is allowed to step upon them) with dead loads four times as great as the maximum weights they are to carry. The planks or boards that are used for the floors of scaffold platforms should be sound and strong, and they should cover the entire width between the supports. They should also be placed close together to prevent materials and tools from falling through, and the ends of the planks should be fastened or supported so that they cannot tip or slide. Pole scaffolds should be effectively braced and stayed to prevent collapse or overthrowing, and all scaffolds that extend more than six feet above the ground or floor should be provided with hand-rails and toe-boards at every platform. Foremen should see that the platforms are not overloaded, and should also see that the helpers deposit the materials upon the platform gently. Throwing loads down upon them from the shoulder should never be allowed.

Scaffold construction has not received the attention in this country that it deserves, and the Engineering and Inspection Division of THE TRAVELERS INSURANCE COMPANY will gladly furnish, without charge, further and more detailed suggestions for insuring safety in practical scaffold work. (See also HOISTING MACHINERY, LADDERS, LAWS AND ORDINANCES, and RAILINGS AND TOE-BOARDS.)

SCRAP: See RUBBISH.

SET-SCREWS: See SHAFTING.

SHAFTING: Ends of shafting that project beyond bearings or pulley hubs more than 2 inches, and that are within 6 feet of a floor or platform, should be cut off or boxed in. Care should be taken to see that the shafting runs true, that the hangers are properly located and securely fastened, and that the lubrication is ample. Safety set-screws, with slotted or hollow heads, should be substituted for those of the projecting type, and all couplings should have their bolts and nuts

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covered by shields, or should be of the safety type, with countersunk bolt-heads and nuts, or with rim flanges. All shafting that is less than six feet from the floor should be entirely inclosed by wire netting, or by wooden or metal housings. Vertical lines of shafting that pass through floors should be boxed in to a height of at least six feet above each floor.

SHOES: See CLOTHING.

SICKNESS: No employee should be permitted to remain at work about moving machinery, nor in any other place of danger, if sick or otherwise partially incapacitated. This applies not only to serious illness, but also to slighter indispositions; because faintness or nausea or dizziness or other symptoms that deprive the employee of the full, free, and normal use of the faculties may result in bad injuries. Sick persons should be sent to the doctor, or to the hospital if the plant maintains one. Any employee found to be suffering from contagious disease of any kind should be removed from the workplace, and the case should be promptly reported to the Board of Health, if the disease is of such a nature that a report of this kind would be expected or required. Employees who are subject to epilepsy, or to other chronic ailments or infirmities that make them more likely to be injured than other employees, should be set at work at tasks fitted to their condition. The same principle applies to employees who have other limitations such as deafness or defective sight, or who are maimed or crippled. See also DOCTORS, INTOXICATION, and SANITARY CONDITIONS.)

SIGNS: Warning signs should be placed at dangerous points and they should be printed in several languages whenever this appears to be desirable, so that all employees can read them. Foremen should make sure that the warnings are understood by every person who may be exposed to danger; and if any employee is unable to read, the foreman should explain the meaning of the signs orally, using an interpreter whenever this may be necessary. Foremen should always remember, however, that it is far better to cure a dangerous condition, by guarding or otherwise, than it is to merely call attention to it by a sign. (See also FOREIGNERS, INSTRUCTION, and RULES.)

SLINGS: See HOISTING MACHINERY.

SLIVERS: Slivers should be carefully removed from floors, platforms, railings, and ladders, and from all boards and planks that are situated so that any person may come in contact with them.

SPITTING: See NEATNESS.

STAIRS AND STAIRWAYS: Every workplace should have a sufficient number of broad, well-designed stairways to enable all employees to leave the building safely in a very short time. The stairs should not be built at a steeper angle than 37 degrees (corresponding to a rise of three feet to every four feet of horizontal distance), and the treads and risers should be proportioned so that the danger of tripping and falling is reduced to a minimum. Stairways broken by landings of generous size at each floor are preferable to those that extend for several stories in one almost continuous line; but the passages or landings that lead from each flight to the next should be broad and easy to follow, and all stairways and landings should be well lighted.

A strong hand-rail, placed 36 inches in a vertical direction above the center of the tread of the stairs, should be installed on each side of every stairway that is more than four feet wide, and stairways that are narrower than this should have a hand-rail on at least one side. A stairway that is eight feet wide or more should also have a rail down the middle. Stair wells should be inclosed, or should have toe-boards and double rails at each floor. (See RAILINGS AND TOE-BOARDS.) When rails are used, the upper one should be at least 42 inches above the floor, and both rails should be substantially constructed and solidly secured. Nonslip material, when used on stairs, should be kept free from holes, and should not be allowed to curl or roll up. Abrasive-metal treads are very effective, and are far more durable than those covered with rubber and other similar materials. (See also DOORS, FIRE PRECAUTIONS, and PANICS.)

STOPS, SAFETY: See ENGINE ROOMS.

STORAGE: Passageways, gangways, and stairs should not be used for the storage of stock, materials, or implements of any kind. Stock piles should be laid up level, and should not be allowed to lean in any direction. They should rest upon a secure foundation, and should not be carried up to a needless height. If necessary, they should be braced to make them secure against falling. Barrels and casks, when placed on their sides, should be securely blocked to prevent rolling; and when they are stowed on end, in tiers,

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the upper ones should be carefully and firmly placed upon those below. Stock and materials should be arranged so as to allow ample room for passageways, and care should be taken to prevent overloading the floors of buildings used for storage purposes. (See also Railroad Dangers.)

SUGGESTIONS FROM EMPLOYEES: Foremen should encourage employees to offer suggestions relating to additional or superior safeguards for the machinery and the workplaces, or bearing upon the improvement of the working conditions in any way. Suggestions of this kind should receive careful consideration, and they should be adopted if they are found to be practical. If they are not adopted, the reason should be explained to the employees from whom they came.

SWITCHBOARDS: See Electrical Apparatus.

TEAMING AND TRUCKING: Wagons, trucks, and skids should be kept in good repair, and should be examined frequently for defects. All heavy wagons should be equipped with effective brakes. Horses should be kept "sharp-shod" during icy weather. Muzzles should be provided for horses that bite, and new drivers should be warned concerning the habits of vicious horses that they are obliged to handle. Instructions should be given concerning the best methods of stowing and securing loads, to prevent any part of them from shifting about, or falling or sliding from the wagon.

Motor-driven trucks should also receive careful attention in the matter of repairs and upkeep. The brakes and the steering mechanism should receive special care, to see that they are kept in good working order. Experienced men should be engaged to operate and care for heavy motor trucks, and no unauthorized persons should be permitted to attempt their operation. All employees, other than the regular operators, should be strictly forbidden to tamper with motor cars in any way. (See also GASOLINE.)

TOE-BOARDS: See RAILINGS AND TOE-BOARDS.

TOOLS: All tools should be kept in good repair, and it is advisable to examine them periodically and put them in proper condition. The heads of sledges, axes, and other similar implements should be fastened securely to the handles, and broken or split handles should be promptly replaced. No employee should be permitted to use

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sledges, cold chisels, or other similar tools, having burred or mushroomed heads. Tool boxes or racks should be placed at convenient points, and the tools should be kept in them when not in use. Employees should be carefully instructed, whenever necessary, in the use of sharp-edged or otherwise dangerous tools and implements.

TRENCHES: See Excavations.

UNEMPLOYED PERSONS: No person should be permitted to remain in or about the workplace unless his duties require him to be there. Employees who are temporarily out of work should be required to leave, unless it is likely that they will be needed in a short time. Visitors should be required to obtain passes before they are admitted to the workplace, and when they have been admitted they should not be allowed to go into dangerous places. Visitors take the attention of the employees from the work, and this tends to produce accidents. Cameras carried by visitors should be excluded for the same cause, unless they are needed for good and sufficient reasons.

VAPORS: Smoking, and the use of oil lanterns, acetylene torches, and other open-flame lights, should be strictly forbidden in connection with the handling of paints and other fluids that contain alcohol, crude oil, benzine, "banana oil", bisulphide of carbon, or other volatile and inflammable substances. Most of these vapors are poisonous or toxic, as well as inflammable; and workrooms and other closed spaces in which they occur should therefore be ventilated as thoroughly as possible. Respirators of approved design should also be provided for the employees, when the conditions are such that they are needed. Similar precautions should be taken when persons are working in an atmosphere containing chlorine, sulphur fumes, acetylene, carbon monoxide, or other poisonous or inflammable fixed gases. Ventilating hoods in connection with suitable exhaust systems should be installed over vats containing poisonous acids and chemicals, and over all other vessels from which offensive or unhealthy vapors, gases, and fumes may be given off. (See also ARTIFICIAL RESPIRATION, CHEMICALS, GAS, and PAINTING.)

VENTILATION: It is important to provide for the thorough ventilation of all workplaces, particularly when the air is vitiated with dust, or with injurious fumes, gases, or vapors. Exhaust fans fitted with suitable ducts and pipes usually

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give the best service. Care should be taken, however, to arrange the system so that the employees will not be exposed to objectionable drafts. (See also GAS, PAINTING, and VAPORS.)

VISITORS: See UNEMPLOYED PERSONS.

WINDOWS: Cords, pulleys, and weights should be kept in good condition, so that the windows may be opened and closed with ease. When windows are not counterweighted, catches of some kind should be provided for holding them open, and they should never be propped up by sticks or tools. Broken panes should be removed as soon as possible, and new ones substituted. Throwing articles out of windows should be strictly forbidden. Safety belts should be provided for the use of persons engaged in cleaning windows on the outside, and no person should be allowed to perform work of this kind without using a belt. Window cleaners should not be permitted to rest their ladders directly against the glass. For cleaning large show windows near the ground, substantial stepladders should be used, or straight ladders leaning against some solid part of the building above the glass. In cleaning narrower windows a stout cross-piece may be nailed to the side-bars of the ladder near the top, long enough to bear against the wall at both sides of each window.

WIRE ROPE: See HOISTING MACHINERY, and ELEVATORS.

WIRES: See ELECTRICAL APPARATUS.

WOOD ALCOHOL: Wood alcohol is an active poison, and all bottles, cans, casks, and other vessels that contain it should be plainly labeled, and should be marked "POISON" in some conspicuous and unmistakable way.

WOUNDS: See INJURIES.

WRECKING: In wrecking or demolishing a building, the work should be done in an orderly and systematic manner. Weak walls should be shored up before any part of the structure is disturbed. The building should be taken down story by story, each story being cleared before work is begun on the next one. The material should not be allowed to accumulate on the floors, but should be removed as it is taken down. It should be lowered by ropes, or sent down through properly-constructed chutes, and nothing should be thrown down unless watchmen are posted to

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keep all persons out of the danger zone. Walls should never be pulled down bodily, unless special precautions are taken to insure safety. Railings, stairs, and other parts tending to promote safety should be left in position as long as possible. (See also Nails, and Rubbish.)

YARD CONDITIONS: Loose boards and lumber, bricks, stones, scrap, and waste materials of other kinds should not be allowed to collect in the yards of manufacturing plants; and stock and other material that is of value should be carefully stored in piles. Shovels, rakes, and other similar implements should not be left lying about, and when they are laid aside temporarily their points or sharp edges should be turned downward. Open holes should be effectively guarded, and should be covered over as soon as practicable. Manhole covers should be set flush with the surrounding surface, as nearly as possible, and their handles should be countersunk or otherwise arranged so as not to project above the surface of the covers. Smooth walks should be provided, as nearly level as practicable, and these should be sanded when coated with ice, and should be cleaned off without needless delay. (See also Excavations, Nails, Rubbish, and Storage.)

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